DESIGN AND MONITORING ROOM SECURITY WITH IMAGE CAPTURE BASED *INTERNET OF THINGS* (IOT) AND *ARTIFICIAL INTELLIGENCE* (AI)

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ABSTRACT
A security system is a mechanism that eliminates fear, anxiety, and worry associated with leaving valuables behind, thus freeing a person from all risks. A security system for facial recognition or a person's identity when entering a room that has valuable value is supplemented by a notification through a smartphone. With this system, it can make it easier and remind a person to supervise their valuables. So that the room can be*monitored* based on *the Internet of Things* (IoT) in combination with *Artificial Intelligence* (AI) technology and notifications through the Telegram application. The method used to support the design of the security system with image capture is a descriptive quantitative method with a *prototyping model*. *Prototyping* is an approach method in which the initial model or *prototype* of the system to be developed is created and tested before full development begins.The results of the study show that room security systems based on *the Internet of Things* (IoT) and *Artificial Intelligence* (AI) can be done well. However, there are still some improvements and developments so that the design can be used or functioned optimally by users.

Keywords: Security Systems, Internet of Things (IoT), Artificial Intelligence (AI)

1. INTRODUCTION

Based on the databox, theft cases in Indonesia are very frequent. Data from the National Police of the Republic of Indonesia (Polri) from January to April 2023 revealed that there were 137,149 cases of crime in Indonesia and 53,186 of them were cases of theft with break-ins, violence, and murder. With many cases of rampant theft. Then many people will feel that the person's valuables and lives are not safe.

When a person is faced with a theft case directly, the person can immediately report and ask for help from the authorities and local residents. However, when cases of indirect theft such as house break-ins, theft in public places, or theft of office equipment. This can make a person anxious, and afraid of losing valuables. Therefore, a security system is needed that can support a person to remain safe, calm, and comfortable in carrying out their daily activities.

A security system is a system to protect valuable items that are left behind so that they can avoid or reduce a person from a dangerous situation, free from fear, a sense of loss or anxiety. To find out the theft of valuables is included in a security system. As a facility in the security system, it can be in the form of sensors, cameras, and codes in both the form of letters and numbers.

Design is the depiction, planning, and sketching or arrangement of several separate elements into a whole and functional unit[1]. And *Monitoring* It is the process of collecting and analyzing information based on indicators that are determined systematically and continuously about an activity or program so that corrective actions can be carried out for the further improvement of that activity[2].

Internet Of Things or often called IoT is an idea where all objects in the real world can communicate with each other as part of an integrated system using the internet network as a link[3]. *Internet Of Things* (IoT) is a concept in which internet connections are extended to physical devices used in daily life[4]. An example of IoT is the existence of CCTV technology whose users can access the results of monitoring using smartphones without any distance from the device.

Artificial Intelligence (AI) is an intelligent system that allows a program or equipment to do everything like a human[5]. This intelligence can be combined with several devices that are developing in the modern era. One of the equipment that can support the existence of *Artificial Intelligence* (AI) in modern times is a camera. The camera can be programmed and processed with microcontroller technology.

Based on the background of the problem, the author is interested in knowing the process and developing equipment to monitor room security based

on *the Internet of Things* (IoT) combined with *Artificial Intelligence* (AI) technology and notifications through the Telegram application. Therefore, the author raised a title "DESIGN AND MONITORING ROOM SECURITY WITH IMAGE CAPTURE BASED INTERNET OF THINGS (IOT) AND ARTIFICIAL INTELLIGENCE (AI)".

2. METHOD

The method used for this study is a quantitative descriptive method. Quantitative descriptive research is research by describing, researching and explaining something by drawing conclusions from numbers[6]. In this quantitative descriptive research, it is supported by an applied research model.

In the applied research model used to support in carrying out the design of security systems with image capture is the *Prototyping*. A prototyping model is an initial method of a system to be developed that is created and tested before being fully developed[7].

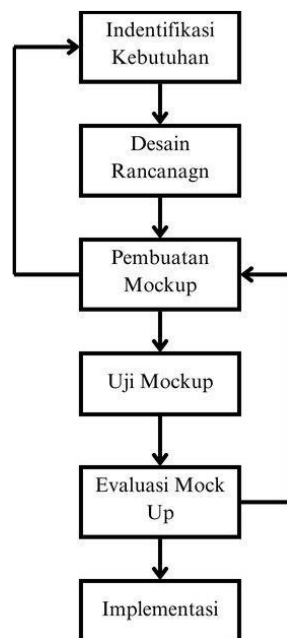Here are the general steps in *a Prototyping* model:

Figure 1 Type *Prototyping*

The research design of this *prototyping* model starts from identifying the needs of the project to be developed which will then be made with the project design design. If the design has been made, a mockup is made. The results of the mockup were tested and evaluated. If the results of the testing and evaluation are good, the project can be implemented.
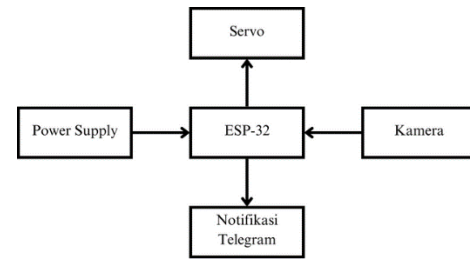
Figure 2 Design Diagram

The mockup design diagram starts from the *power supply* providing voltage to the ESP-32 microcontroller to be able to activate and work. The ESP-32 provides voltage to the camera so that the camera is active and can provide captured images. The camera image results are managed and processed by a microcontroller. In addition, if the face is not recognized, it will send an image and notification on Telegram.

For the way the design works, the beginning of the system works is with the camera to carry out image observation in the room. After that, the camera detects with or without movement of people. With the movement of the person, the camera follows the person for a few seconds until the person's face can be detected. If the face is identified or recognizable, there is no notification and it is considered safe.

When the face is not recognized, the system will capture the image and send it to the Telegram user. So that users get hazard notifications and information related to the condition of the room at that time.
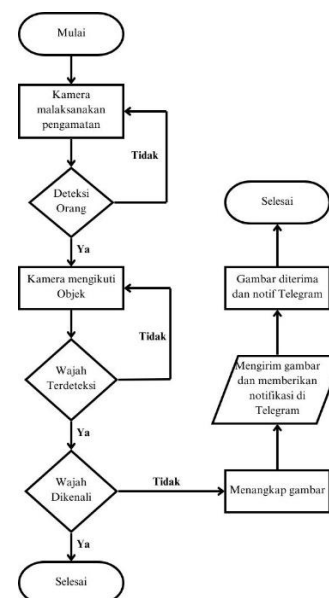
Figure 3 Flowchart how it works

3. RESULT AND DISCUSSION

A. Identify

The results of the identification of needs by conducting a literature study and it was found that to create this security system, several

security systems are needed that are desired by users, which are as follows;

1. A security system that uses *face recognition* access and can be monitored from the web.
2. A security system that can provide notifications directly to users through Telegram.

B. Design Mockup

At this stage, describe or design an equipment or product for a reference in the process of making a tool or product, with the aim of being more systematic and directed so as to reduce or minimize an error.
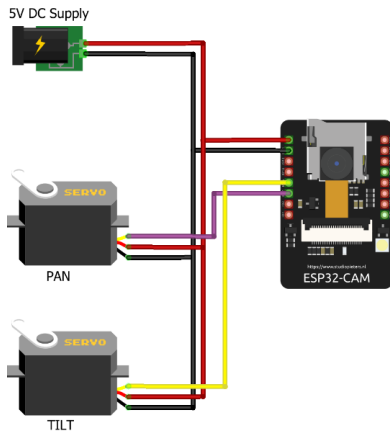

Figure 4 Mockup Design

C. Creation Mockup

The ESP-32-Cam module, one of the Arduino modules, has been integrated with a camera connected to a servo motor as a *pan* and *tilt* camera. To integrate the Telegram hardware and application, an internet connection in the form of wifi is needed.
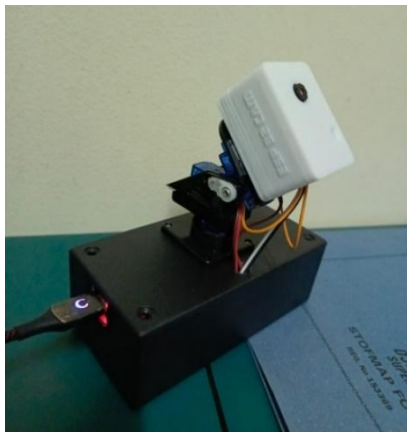

Figure 5 Mockip Design Results

D. Test Mockup

1. Device Testing

The time from activating the project to getting Telegram messages is in the following table:

Table 1 Messaging test at device startup

	Messaging
First Test	7.40 seconds
Second Test	7.32 seconds
Third Test	6.40 seconds

2. Webserver *testing*

The results of the functions of the *webserver* performance are in the following table:

Table 2 Testing the function of the button on the WebServer

	Button Function
Camera Monitor	Can do monitoring only
Face Detection	Can detect faces
Add Face	Can add faces
Security Access	Can perform facial recognition
Take Photos	Can take photos and send them to Telegram
LED Flash	Can turn off and on the LED Flash
Left	Can change the position of the camera to the left
Right	Can change the position of the camera to the right
Above	Can change the camera position upwards
Below	Can change the camera position downwards
Delete Face List	Can unlist any name
Delete All Face Lists	Can delete all face lists

3. Testing of face detection results

To perform a test on face detection in sunlight conditions can be generated in the following table:

Table 3 Testing on face detection in sunlight conditions

	1 m	1.5 m	2 m	2.5 m	3 m
First Test	V	V	V	V	X
Second Test	V	V	V	V	X
Third Test	V	V	V	X	X

To perform a test on face detection in room light conditions can be generated in the following table:

Table 4 Testing on face detection in room light conditions

	1 m	1.5 m	2 m	2.5 m	3 m
First Test	V	V	V	X	X
Second Test	V	V	X	X	X
Third Test	V	V	V	X	X

4. Testing security access results

To perform a test on access from a list of faces in sunlight conditions can be generated in the following table:

Table 5 Safety access testing in sunlight conditions

	1 m	1.5 m	2 m	2.5 m	3 m
First Test	V	V	V	V	X
Second Test	V	V	X	X	X
Third Test	V	V	V	X	X

To perform a test on access from the face list in room light conditions can be generated in the following table:

Table 6 Security access testing in room light conditions

	1 m	1.5 m	2 m	2.5 m	3 m
First Test	V	V	X	X	X
Second Test	V	V	V	X	X
Third Test	V	V	X	X	X

5. Testing Telegram delivery results

To perform a photo capture test on a *webserver* can send images with the time range in the following table:

Table 7 The range of the photo shoot on WebServer to Telegram

	Photo Shoot
First Test	9.40 seconds
Second Test	4.47 seconds
Third Test	7.41 seconds

To test security access on the *webserver*, if the face is correct with the data, it can send a message with the time range in the following table:

Table 8 The range of sending messages when faces are recognized to Telegram

	Messaging
First Test	10.05 seconds
Second Test	4.40 seconds
Third Test	Ethics

To test security access on the *webserver* if the face is not correct with the data, you can send messages and photos with the time range in the following table:

Table 9 Messaging and photo taking range to Telegram

	Messaging	Image Submission
First Test	7.18 seconds	15.24 seconds
Second Test	5.65 seconds	17.11 seconds
Third Test	9.19 seconds	15.57 seconds

E. Evaluation Mockup

Evaluation of systems and equipment that have been designed in accordance with existing needs and there are evaluations as follows:

a. This Room Security System tool can work normally and has a function as a result of the tool.

b. Sending messages to Telegram and accessing *the webserver* adjusts the state of the wifi.

c. This room security device does not have a human detector and cannot follow objects or people.

F. Implementation

In this implementation, the researcher installs the design of the designed equipment at the location to be determined, namely in one of the laboratories at the Aviation Polytechnic of Surabaya.

4. CONCLUSION

Based on the discussion of the results of "DESIGN AND MONITORING ROOM SECURITY WITH IMAGE CAPTURE BASED INTERNET OF THINGS (IOT) AND ARTIFICIAL INTELLIGENCE (AI)", the author can conclude that the author does not get a way to detect humans to be included in the creation of room security design done by the author. For the tool it has worked well. However, there are still some evaluations related to the distance to perform scanning or facial recognition, tools that still depend on wifi connections, face detection distances that are quite not far, no detection

and following objects or people. In that case, designing and monitoring room security with image capture can be implemented to maintain security in the room. However, it needs to be improved again regarding the addition of detectors and following objects or people. In addition, designing room security with image capture can send a direct notification regarding the presence of unknown people when entering the room according to the results of face detection on the camera.

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